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Electrochemical behaviour of thiol-derivatised zinc (II) phthalocyanine complexes and their self-immobilised films at gold electrodes

Kenneth I. Ozoemena[a,*], Tebello Nyokong[b]

[a]*Department of Chemistry, University of Pretoria, Pretoria 0002, South Africa*
[b]*Department of Chemistry, Rhodes University, Grahamstown 6140, South Africa*

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Abstract

Electrochemical properties of novel, peripherally substituted zinc phthalocyanine complex, octa(4-methylphenylthio-) phthalocyaninatozinc(II) [ZnPc($SC_6H_4CH_3$)$_8$] (**1a**), in DMF solution are presented. This complex showed five quasi-reversible/reversible, diffusion-controlled redox couples. Solution voltammetry of **1a** showed little contrast with that of its alkythiol-derivative, octabutylthiophthalocyaninatozinc(II) [ZnPc(SC_4H_9)$_8$] (**1b**) in that both thiol-substituents tend to show electron-withdrawing influence on the phthalocyanine ligands; complex **1a** showing easier reduction and more difficult to oxidation when compared to **1b** and other alkyl derivatives. The voltammetric features of the solid ultrathin films of **1a** and **1b**, immobilized on gold electrodes via the self-assembling technique, are also presented. Interestingly, the self-assembled films are stable and reproducible and provide good suppression to the following Faradaic processes; gold surface oxidation, solution ion species and underpotential deposition (UPD) of copper.

Keywords: Zinc thio-phthalocyanine complexes; Voltammetric analysis; Self-assembled monolayer

1. Introduction

Metallophthalocyanines (MPcs) have been a subject of a vast amount of study because of their increasing diverse applications from industrial (catalysts, photoconductors, etc.) to biomedical (photodynamic therapy, PDT) [1]. Zinc (II) phthalocyanine (ZnPc) complexes have in particular been intensively studied with respect to their photosensitising properties [2–5]. Apart from being excellent photosensitisers, ZnPc complexes have also been reported as gas sensors [6–9]. Peripheral substituents on ZnPcs are important since they have been known to influence their properties, such as the electrochemical, photochemical and catalytic behaviour of their thin films, to a large degree [8–12]. MPc complexes that are peripherally substituted with alkanethiol and phenylthiol derivatives show rich electrochemical and photochemical properties [13–18], which

*Corresponding author. Tel.: +27-12-4202934; fax: +27-12-3625297.
E-mail address: kenneth.ozoemena@postino.up.ac.za (K.I. Ozoemena).

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